

Summary of Proton Test on the Actel A1280A at

Indiana University

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Test Facility

The Actel A1280A FPGA was tested at the Indiana University Cyclotron Facility (IUCF). The proton energy was 193 MeV and the flux was set at approximately 2×10^8 p/cm²/sec. The total fluence for each device was determined by the total dose response of the device and its affect on the current draw; details for each device including bias are given in the tables below. The device was irradiated normal to the beam.

Device Under Test

The A1280A devices were in a CPGA176 package and were active during irradiation. All die were from the Matsushita (MEC) foundry with a 1.0 μ m feature size. Upsets and currents were monitored in real-time with the device being clocked at 1 MHz. The stimulation pattern was a 500 kHz square wave. The test pattern used, the TMRA2.C, contains 522 S-Module flip-flops and 40 C-Module flip-flops.

Sample devices were taken from several lots used previously in radiation tests along with a few 'spare devices' to increase sample size. A total of 19 devices were used in this study. The intent of the study was to investigate the proton response of the hard-wired S-Module flip-flops with a large sample size. Previous testing did not detect proton upset within the operating voltage range but used a low fluence.

Test Results

Nineteen devices were irradiated, with 12 devices at a worst-case bias of 4.5V and the remaining 7 devices at a nominal bias of 5.0V. An estimate of the cross-sections, by lot and bias, are given in Table 1 and Table 2, above. Previous tests of the A1280 (1.2 μ m) and the A1280A (1.0 μ m) did not detect proton upset. The large sample size for this study, with upsets detected in each device, shows

that this device is sensitive to protons for S-Modules. No upsets were detected in the C-module flip-flops. However, there was a small number of flip-flops in this pattern so a different pattern should be used for measuring the C-module flip-flops' sensitivity to protons. Note that the C-module flip-flops in the RH1020, tested in June 1998, have a small, but non-zero cross-section for 193 MeV protons.

There was no clock upset detected in any of the devices.

The device's total dose performance falls into the radiation-soft range, typical for devices of this class. The data within a lot was relatively consistent.

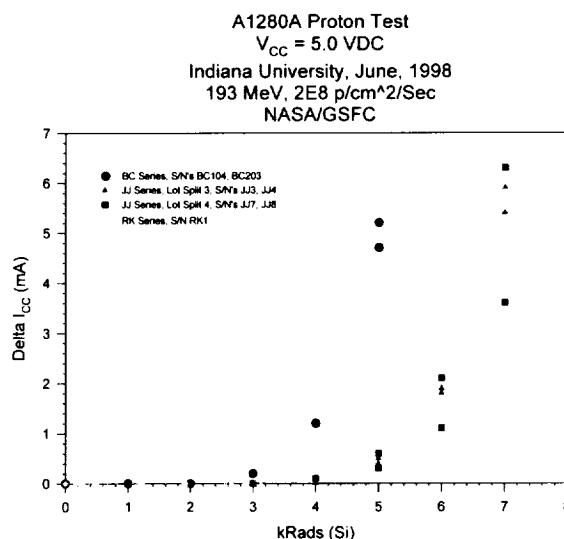
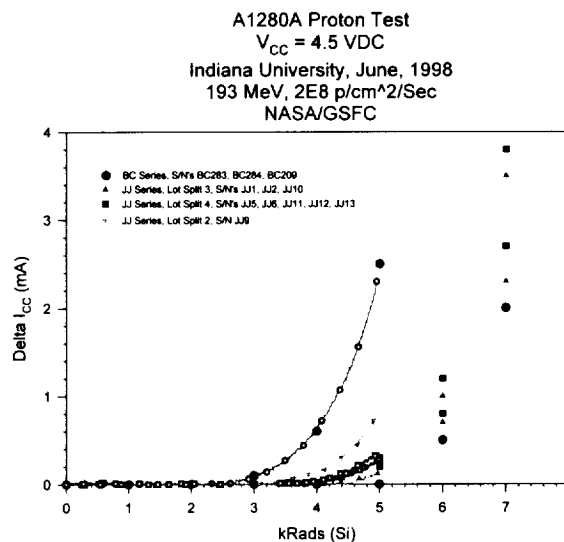


Table 1. Summary for $V_{CC} = 4.5VDC$.

S/N	Lot	Total Dose kRads (Si)	Upsets	Fluence (p/cm ²)	Estimated Cross-Section (cm ² /flip-flop) by Lot
BC284	9424	5	6	80×10^9	96×10^{-15}
BC283	9424	5	2	80×10^9	
BC209	9424	5	4	80×10^9	
JJ9	9614 Lot Split 2	5	5	80×10^9	120×10^{-15}
JJ1	9614 Lot Split 3	7	13	112×10^9	139×10^{-15}
JJ2	9614 Lot Split 3	7	7	112×10^9	
JJ10	9614 Lot Split 3	5	2	80×10^9	
JJ5	9614 Lot Split 4	7	9	112×10^9	165×10^{-15}
JJ6	9614 Lot Split 4	7	14	112×10^9	
JJ11	9614 Lot Split 4	5	6	80×10^9	
JJ12	9614 Lot Split 4	5	4	80×10^9	

Table 2. Summary for $V_{CC} = 5.0VDC$.

S/N	Lot	Total Dose kRads (Si)	Upsets	Fluence (p/cm ²)	Estimated Cross-Section (cm ² /flip-flop) by Lot
JJ3	9614 Lot Split 3	7	7	112×10^9	137×10^{-15}
JJ4	9614 Lot Split 3	7	9	112×10^9	
BC203	9424	5	5	80×10^9	83.8×10^{-15}
BC104	9424	5	2	80×10^9	
JJ7	9614 Lot Split 4	7	8	112×10^9	154×10^{-15}
JJ8	9614 Lot Split 4	7	10	112×10^9	
RK1	9415	5	4	80×10^9	95.8×10^{-15}

